STATUS REPORT ON NASA RESEARCH GRANT

NsG 714

(JULY 1, 1965 to DECEMBER 31, 1965)

"Study of Heat Transfer Through Convective Layers"

During this period the main part of the data for the air system has been taken. The following table summarizes the tests that have been performed to date.

Rayleigh No. Range	Interplate Temp. Range	Plate Spacings
4.4×10^5 to 5.7×10^6	$4.1^\circ C$ to $11.7^\circ C$	17.15 cm 10.78 cm 8.88 cm

The data for the large spacings have been completely analyzed. The Rayleigh number range for these spacings is from 6.9×10^5 to 5.7×10^6. The heat transfer data are correlated in terms of Nusselt numbers and Rayleigh numbers. The general form of the correlation is

$$Nu = \text{constant } (Ra)^n$$

For high Rayleigh numbers the correlation follows the usually assumed 1/3 power law:

$$Nu = 0.067 \times Ra^{1/3} \qquad (Ra > 1.5 \times 10^6)$$

For the whole range of the Rayleigh numbers, the data are best fitted by the following expression:

$$Nu = 0.1777 \times Ra^{0.2681}$$

The standard deviation of the data points from the curve is less than 4.0%. The data can also be represented by a 1/3 power law:

$$Nu = 0.069 \times Ra^{1/3}$$

The two expressions give results within 5.0% in the data range. The accompanying figures show the heat transfer correlations.

The data reduction for the temperature distribution in the fluid layer is still in progress. As stated in the previous report, the temperature distribution follows neither Malkus theory nor the $Z^{-1/3}$ power law derived from mixing length concepts.

More data will be taken for higher Rayleigh numbers. With 25 cm spacing, Rayleigh numbers of the order of 2.0×10^7 can be obtained. By the end of the next period, tests for the air system will be concluded and preliminary runs for the liquid system will begin.

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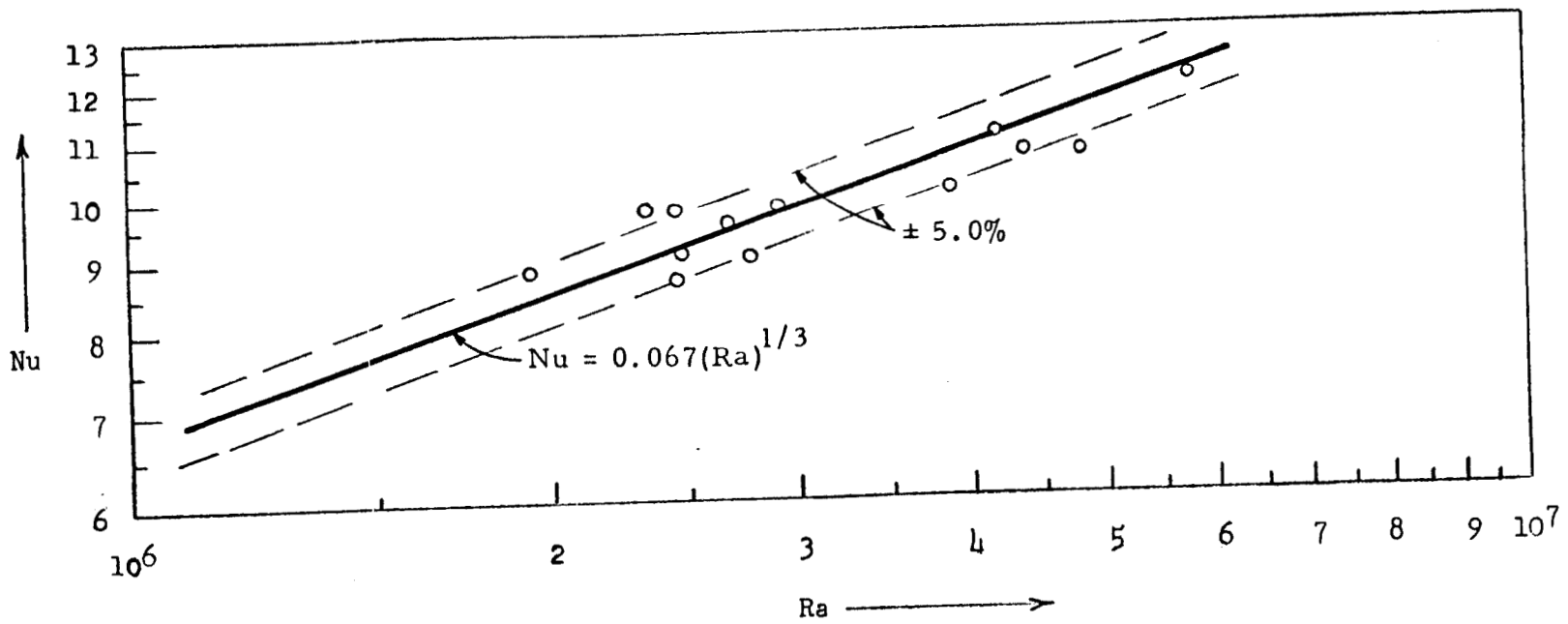

Fig. 1 Turbulent Free Convection Through a Horizontal Fluid Layer

($Ra > 1.5 \times 10^6$)

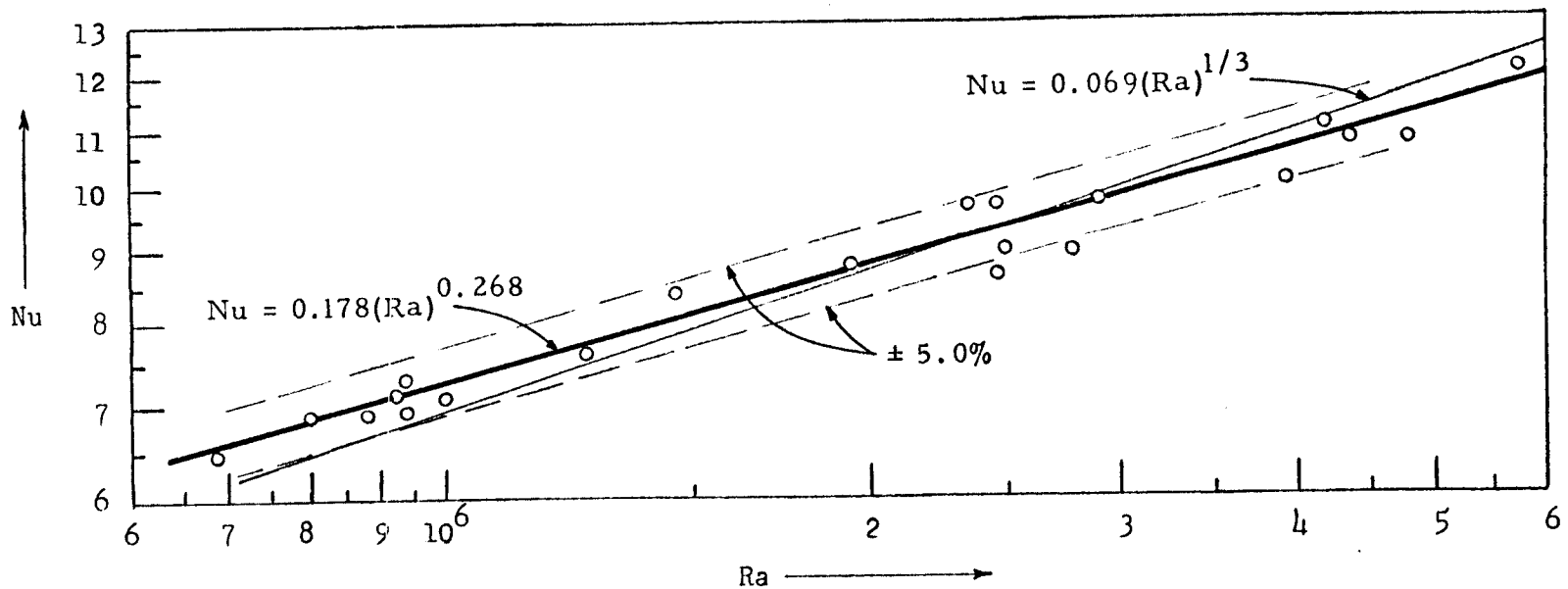

Fig. 2 Turbulent Free Convection Through a Horizontal Fluid Layer